

## Accelerating Uptake of Additive Manufacturing by Aerospace

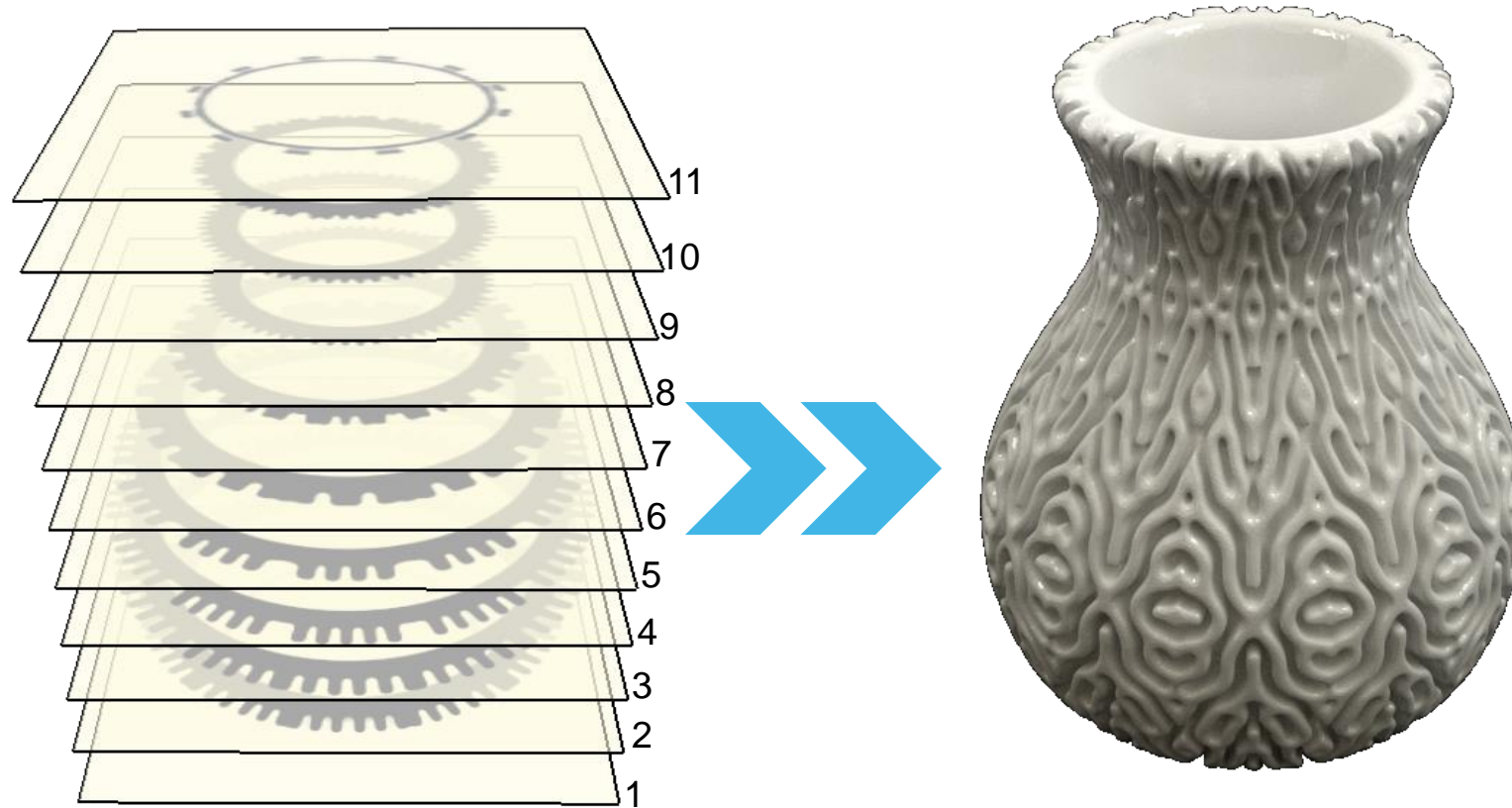
Dr Katy Milne

20<sup>th</sup> Nov 2019



# ADDITIVE MANUFACTURING (AM)

A digitally driven process

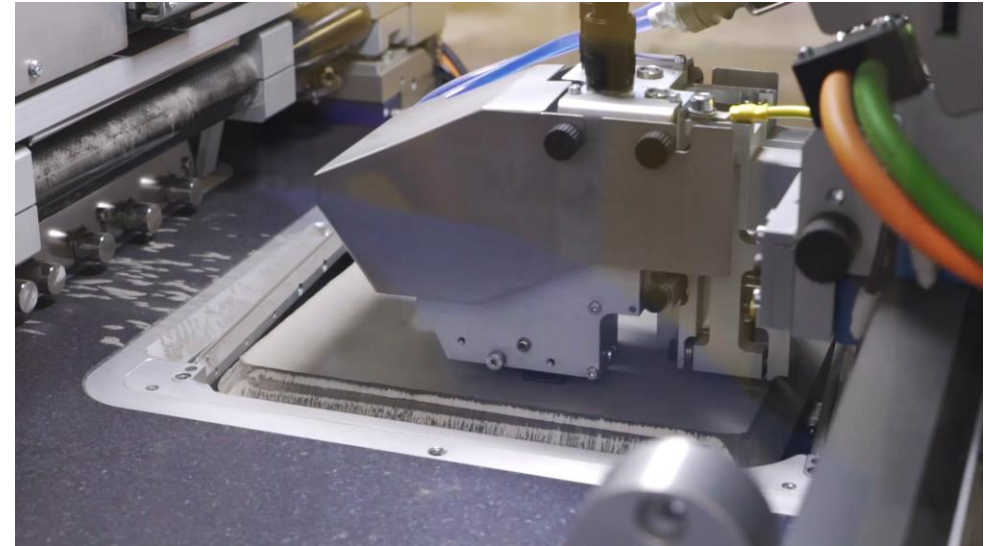
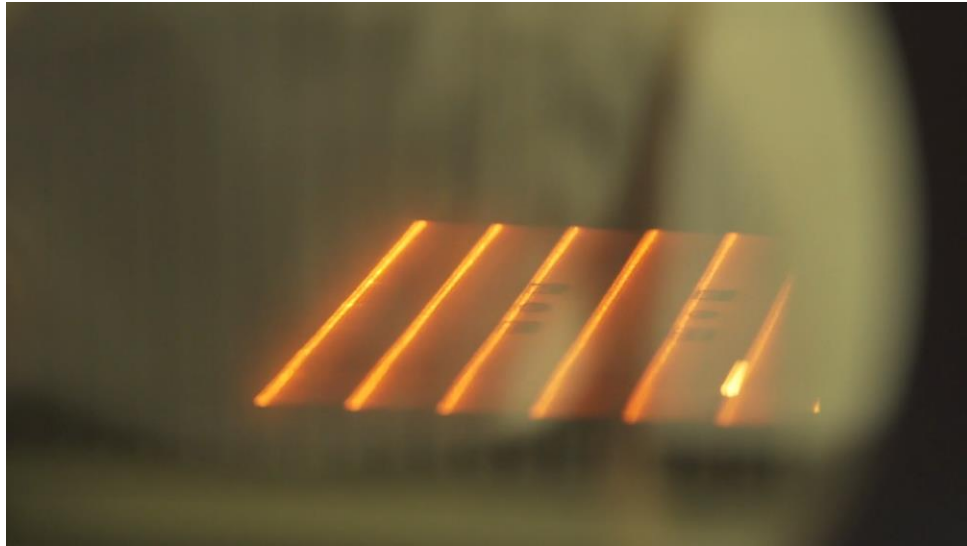


*Source: Shapeways Magazine*

# ADDITIVE MANUFACTURING (AM)

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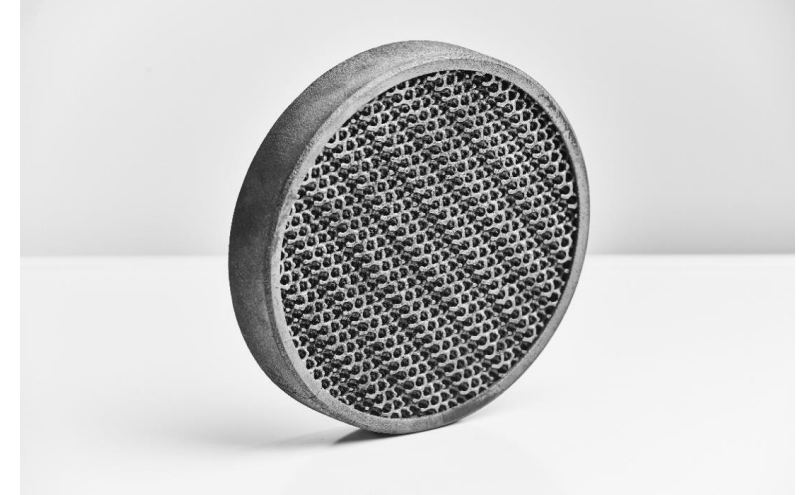
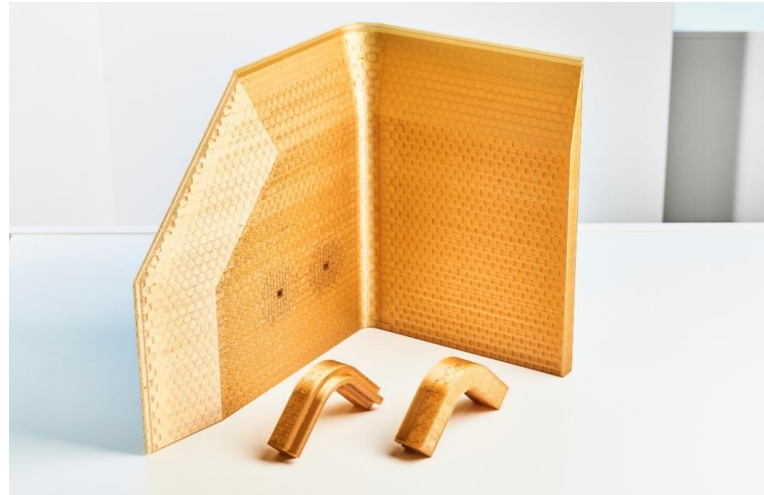
A range of process technologies...





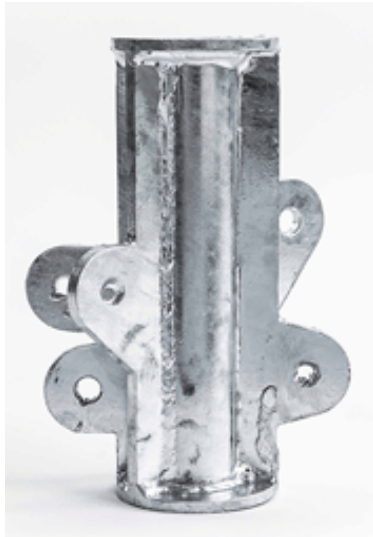
# NEW TECHNOLOGY – NEW OPPORTUNITIES

A range of materials...



# NEW TECHNOLOGY – NEW OPPORTUNITIES

Increased design freedom, increased geometry complexity



Source: [www.metal-am.com](http://www.metal-am.com) (2014)

ESA Earth Return Capsule –  
crushable structure. By MTC and  
Magna Parva.

# NEW TECHNOLOGY – NEW OPPORTUNITIES

Increased material complexity



Multi-material bionic arm by 3D Printing Research Group at University of Nottingham.  
Source: [www.nottingham.ac.uk/research/groups/3dprg/experience-our-group](http://www.nottingham.ac.uk/research/groups/3dprg/experience-our-group) (2013)

# NEW TECHNOLOGY – NEW OPPORTUNITIES

## Part consolidation

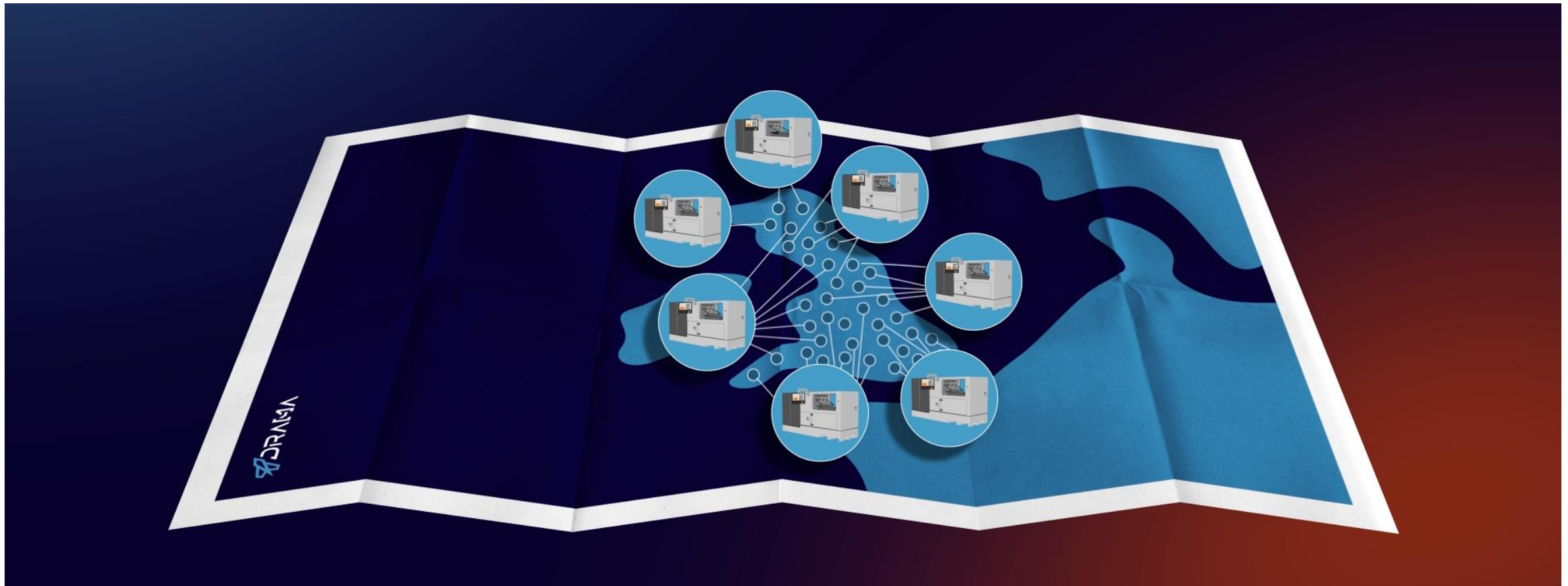


Demonstrator component from National Centre Additive Manufacturing developed in the DRAMA project.



# NEW TECHNOLOGY – NEW OPPORTUNITIES

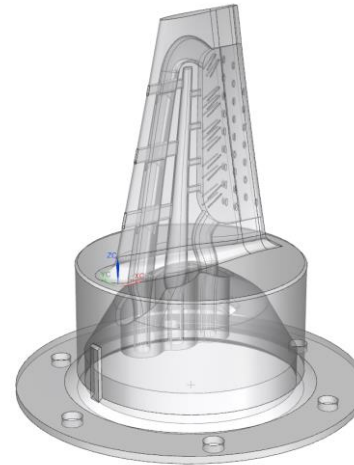
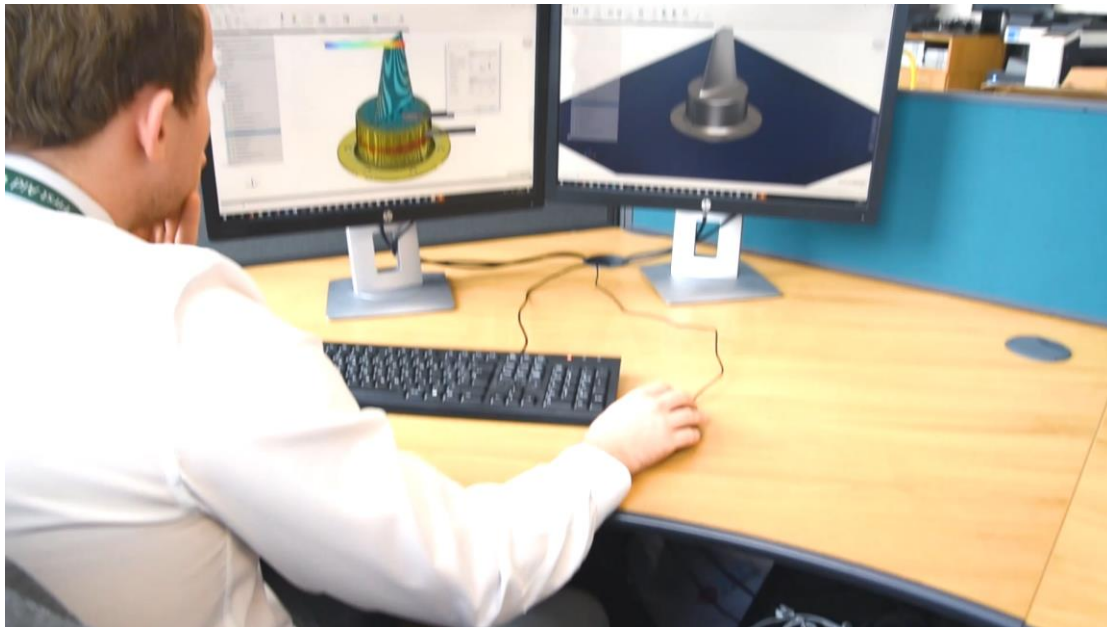
Distributed supply chain



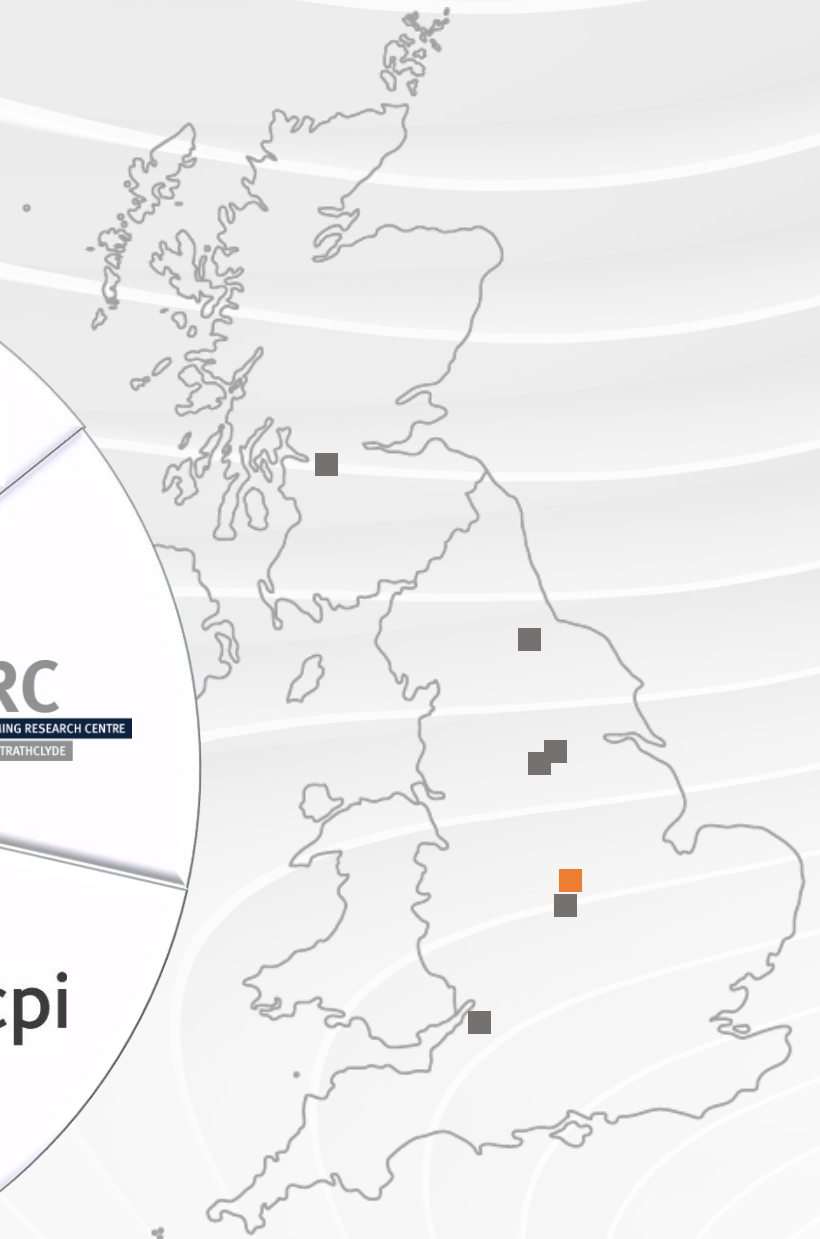


# NEW TECHNOLOGY – NEW OPPORTUNITIES

## Rapid product development



# NATIONAL CENTRE ADDITIVE MANUFACTURING



**The UK's National Centre for Additive Manufacturing (NCAM)**  
is the UK's independent AM body supporting supply chain companies  
adopt and mature additive manufacturing...

Shaping your AM strategy

Maturing your AM process

Improving your workforce  
competency





## Working with the National Centre:

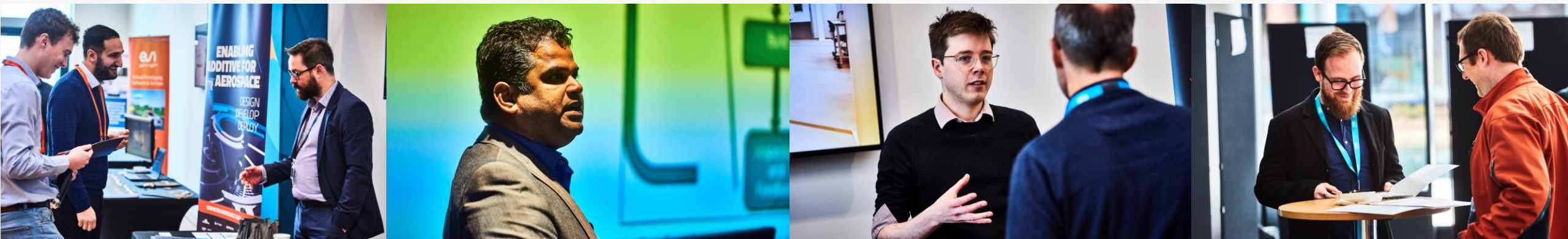
- World-class facilities and expertise covering the whole process chain – from design through to inspection.
- Substantial activity in metal, polymer and ceramics.
- Process and vendor agnostic.





## Working with the National Centre:

- We are the UK's focal point for AM innovation and exploitation, signposting to potential partners.
- We can help you access government support.



## Working with the National Centre:

- The Knowledge Hub is our online reference library.

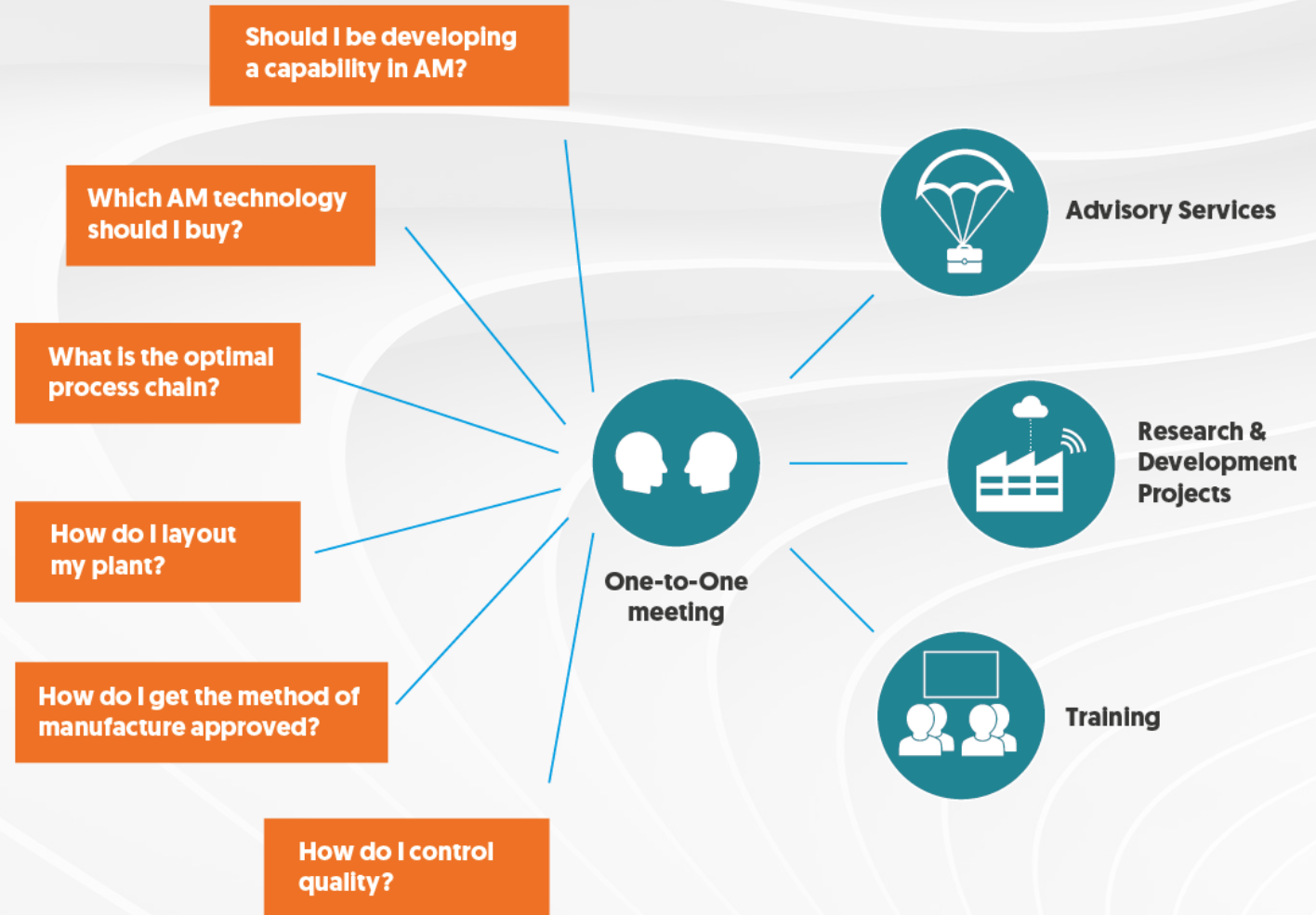


**KNOWLEDGEHUB**

[knowledgehub.the-mtc.org/knowledge-hub](https://knowledgehub.the-mtc.org/knowledge-hub)

## Working with the National Centre:

- Advisory Services
- R&D projects
- Training



# ADDITIVE IN AEROSPACE IN 2017...

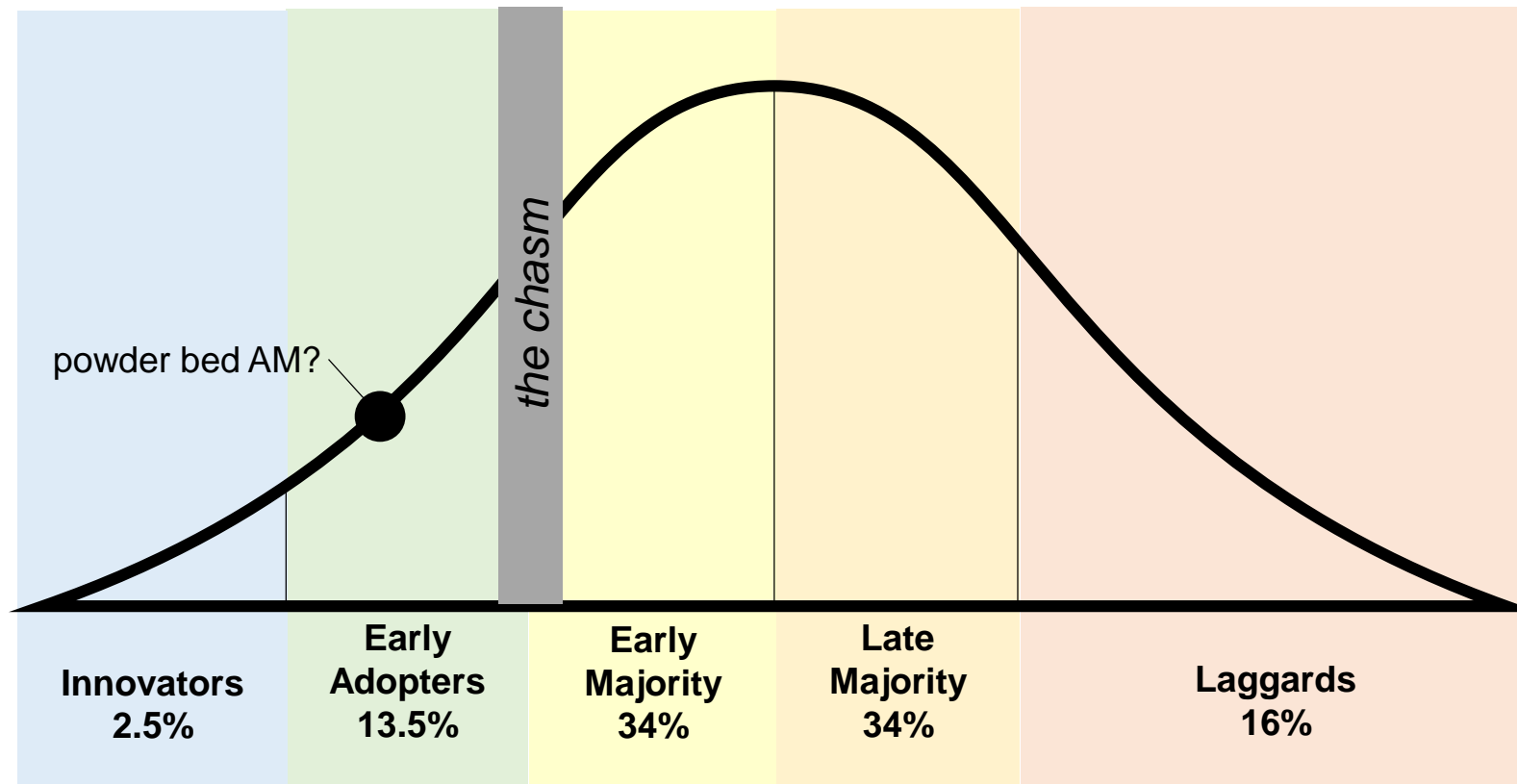
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- Primes rapidly building AM capability within their businesses.
- Some Tier Ones rapidly developing AM capability. Other Tier Ones trying to decide whether to 'dive in'.
- Long tail of the supply chain has varying levels of awareness AM. Unsure how it will affect them – is it an opportunity or a threat?



# DIFFUSION OF INNOVATION – THE CHASM

If the early majority have to undertake the same risk as the innovators and early adopters, the technology will not be adopted throughout the supply chain.



Roger's bell curve from *Diffusion of Innovation*



# **ENABLING ADDITIVE FOR AEROSPACE**

Building stronger supply chains

## Consortium



## Supported by



## Funded by



The DRAMA project is funded by UK Research and Innovation through the Industrial Strategy Challenge Fund.



**AIRBUS**



**BAE SYSTEMS**



**MEGGITT**

**BOMBARDIER**



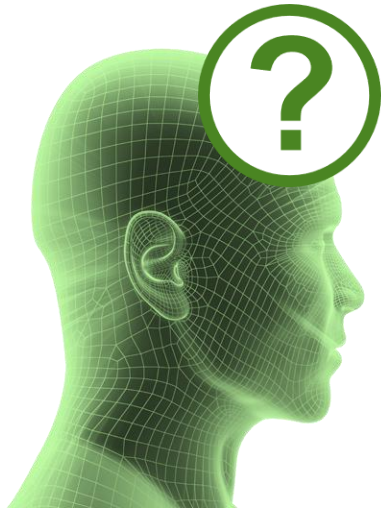
**Collins Aerospace**





# AERO ADDITIVE USERS

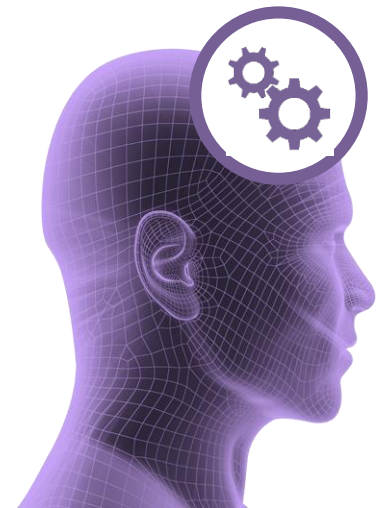
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**Potential User  
(No Capability)**

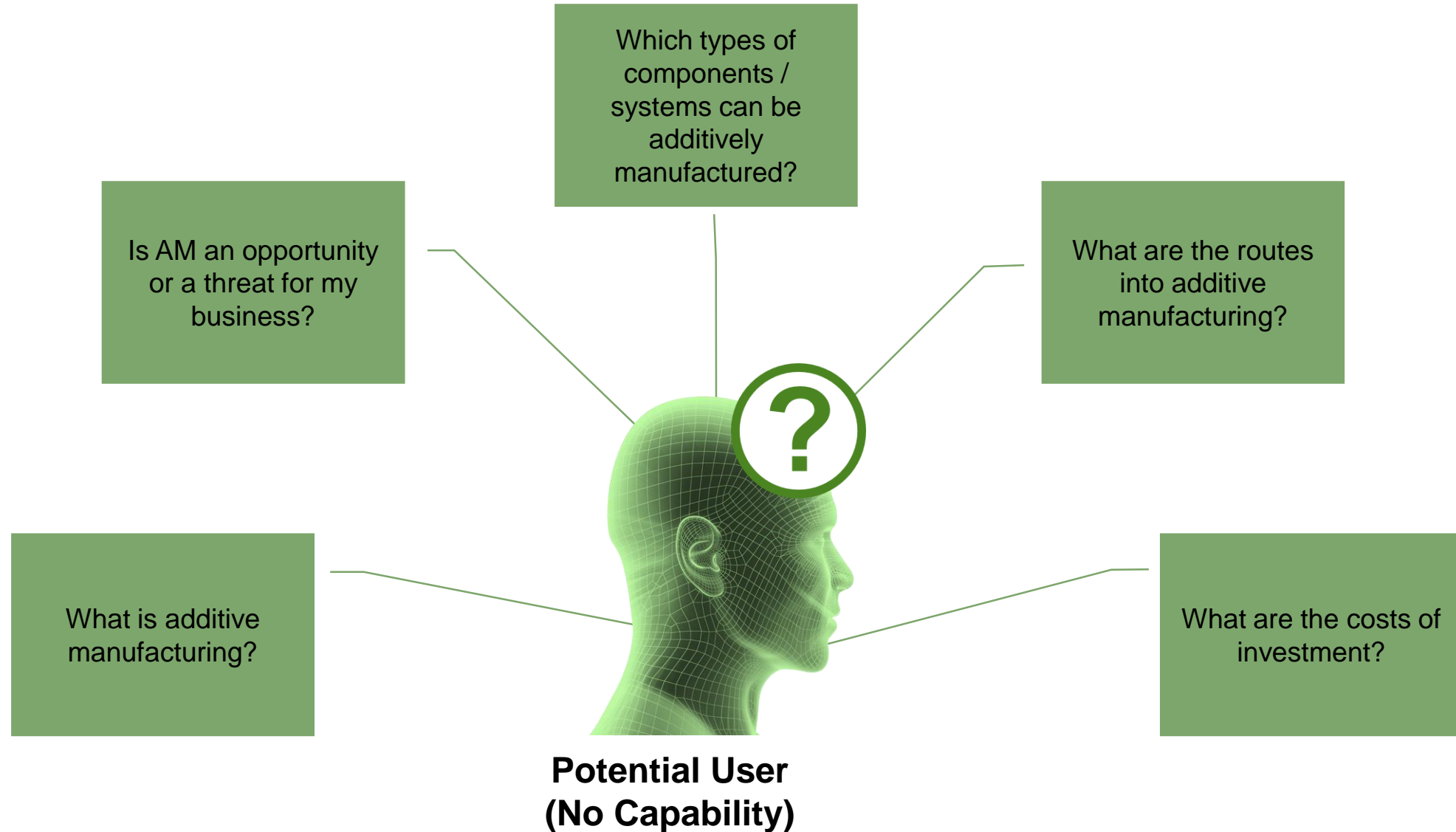


**New User  
(Limited Capability)**



**Experienced User  
(Advanced Capability)**

# POTENTIAL USER



# WHICH COMPONENTS OR SYSTEMS?

**Company:** Harlow Engineering Ltd

## Synopsis:

Harlow Engineering manufactures a very wide range of bus bars in aluminium and copper, many of which are destined for high integrity applications including aerospace.

The low production volumes and complex geometry make these parts expensive to manufacture with a high labour content. Harlow want to understand whether a metal AM powder bed process might be a viable alternative.

## AM Background:

- ☐ Wire arc deposition AM for production parts



# WHAT ARE THE COSTS OF INVESTMENT?

**Company:** Hyde Aero Products Ltd

## Synopsis:

Hyde Aero Products has registered a new subsidiary company which will provide AM parts for aerospace and needs assistance in working through the business case.

To help inform the business case, some sample complex Class III helicopter parts will be built by metal AM.

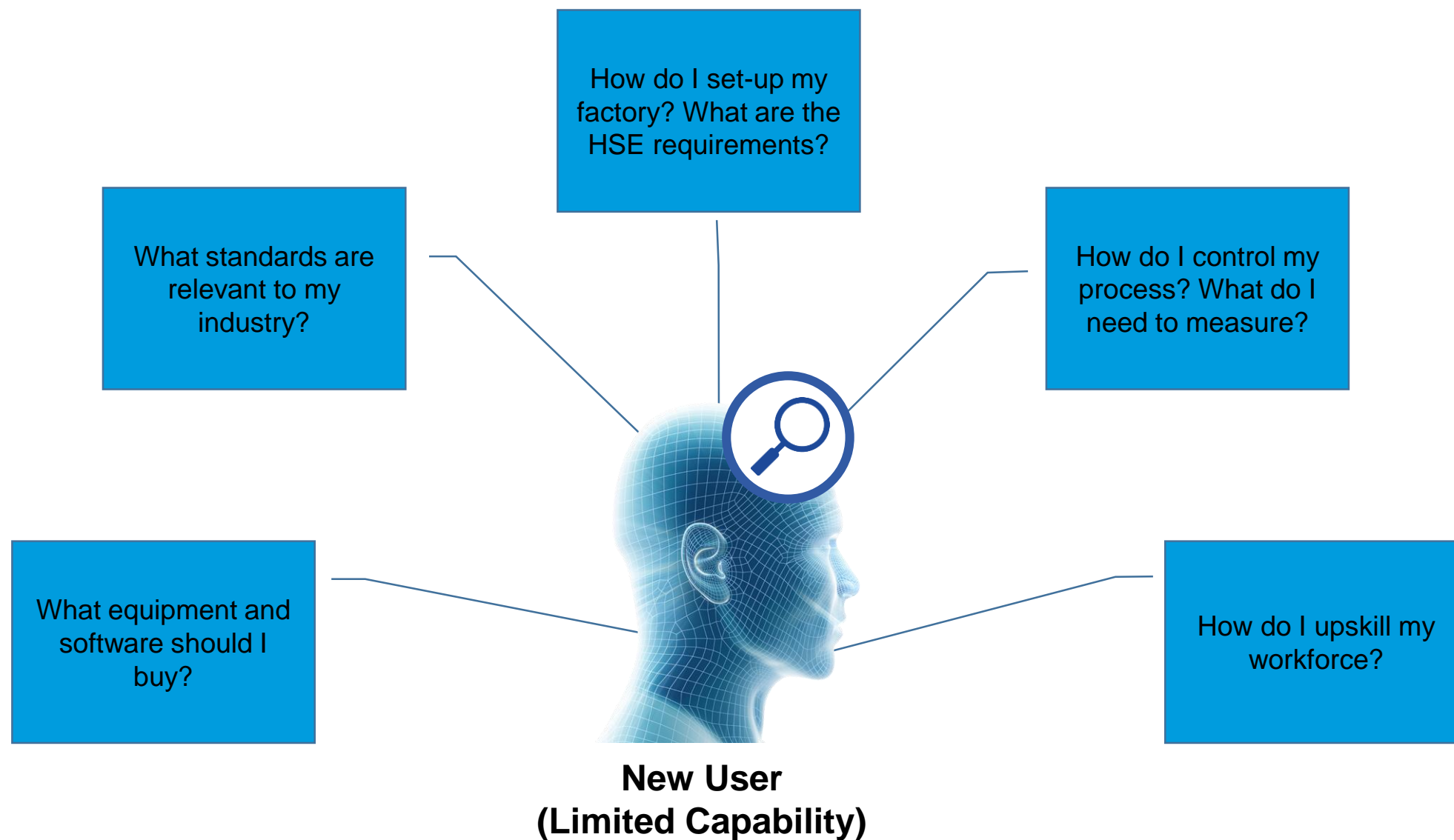
## AM Background:

- ☐ Polymer AM for tooling
- ☐ Experience of design for additive, including optimisation





# NEW USER



# WHAT EQUIPMENT SHOULD I BUY?

**Company:** Glenair UK Ltd

## Synopsis:

For high integrity connector manufacturer, Glenair, polymer 3D printing has been firmly embedded into the business for a number of years, both for specialist tooling and for proof-of-concept prototypes.

Glenair is now investigating metal AM in order to make fully functional prototypes and potentially complete small production runs of complex parts. They want to understand what metal AM equipment to buy.

## AM Background:

- ❑ Polymer AM for tooling and prototypes



# WHAT STANDARDS ARE RELEVANT TO AEROSPACE?

**Company:** Metron Advanced Equipment Ltd

## Synopsis:

Metron has built a reputation for the design and manufacture of high performance metallic components for industries including motorsport, marine, space and medical, using an EBM machine. The company now wishes to extend its portfolio to include aerospace.

Metron want to gain a better appreciation of the additional quality requirements which aerospace customers are likely to mandate for AM parts.

## AM Background:

- ❑ Design and manufacture of prototype and production parts using EBM

**METRON**  
Additive Engineering



# HOW DO I SET-UP MY FACTORY?

**Company:** KW Special Projects Ltd

## **Synopsis:**

Having established a strong background in motorsport, KW Special Projects is currently building a new 1660 m<sup>2</sup> digital manufacturing facility, which will extend its existing polymer AM capabilities to include metals.

KW Specialist are getting help on factory set-up to ensure that the new production facilities are efficiently arranged, take into account aerospace quality requirements, and cater for the added complexity of working with metal powders.

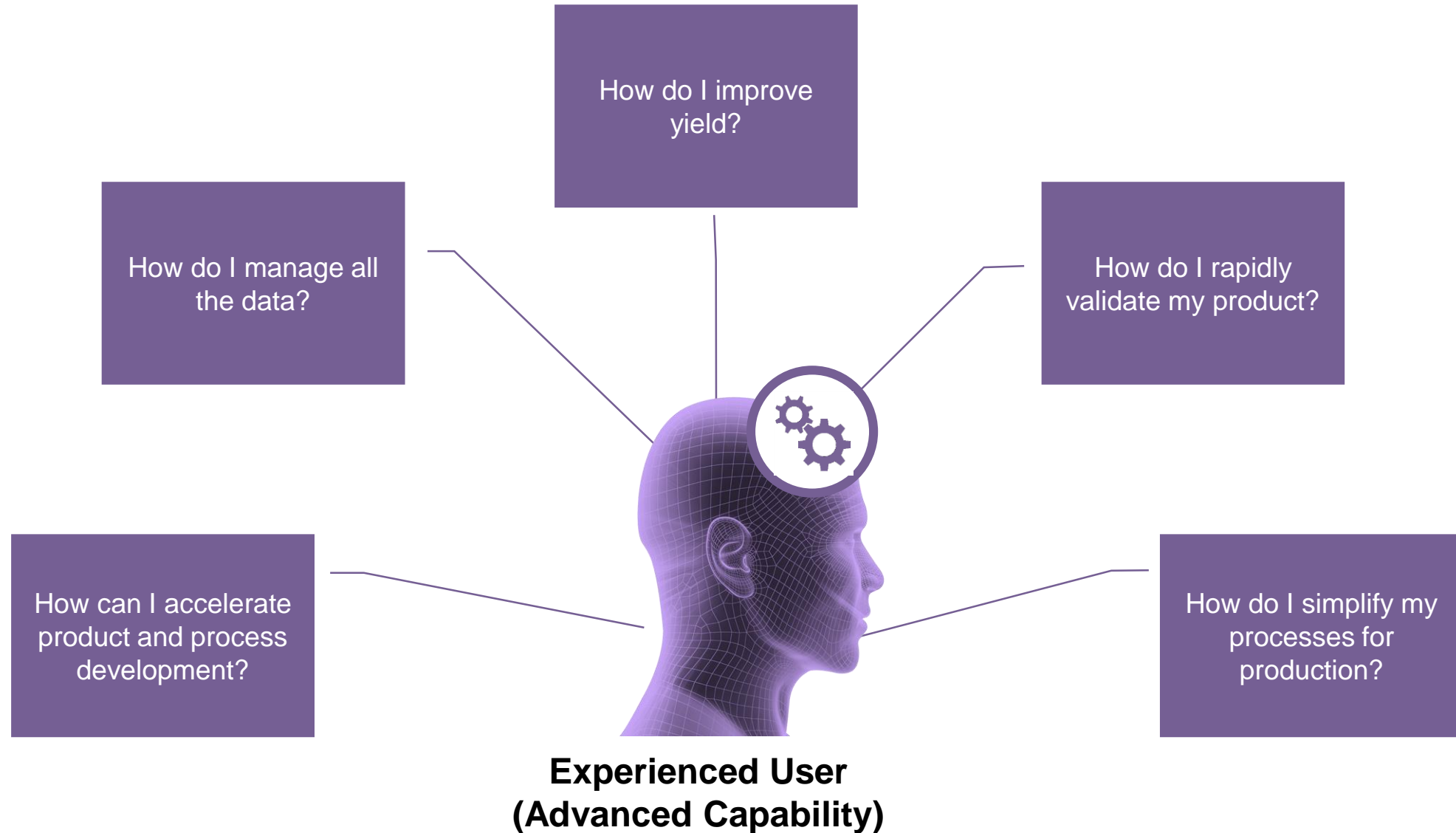
## **AM Background:**

- ☐ Design of 3D printed parts
- ☐ Manufacturing of polymer parts
- ☐ Supply of metal AM parts using external partners

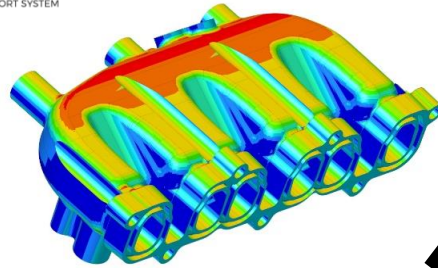




# EXPERIENCED USER



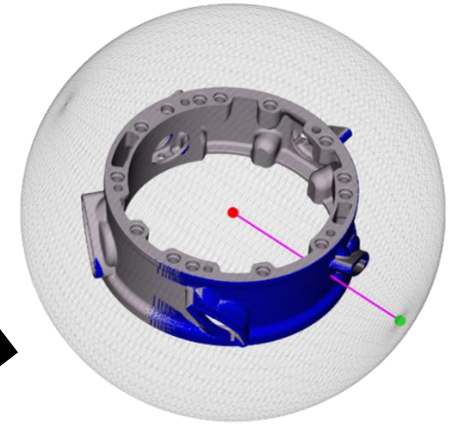
# HOW CAN I ACCELERATE DEVELOPMENT?



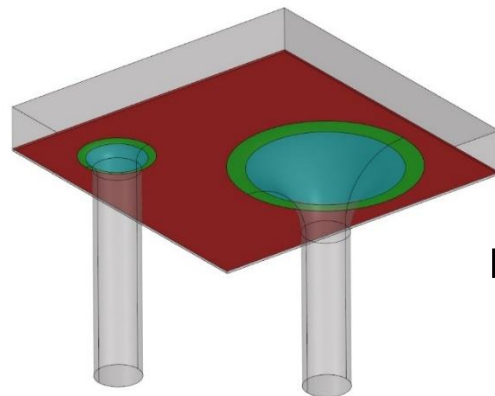
Design for build – surface roughness (Altair)



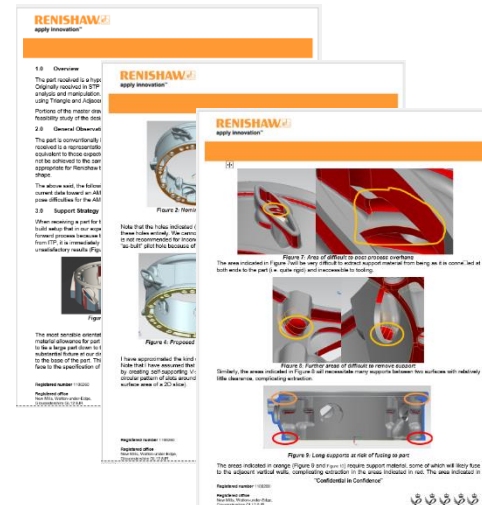
Design for powder removal (MTC)



Design for optical inspection (MTC)



Design for build – transitions (Altair)

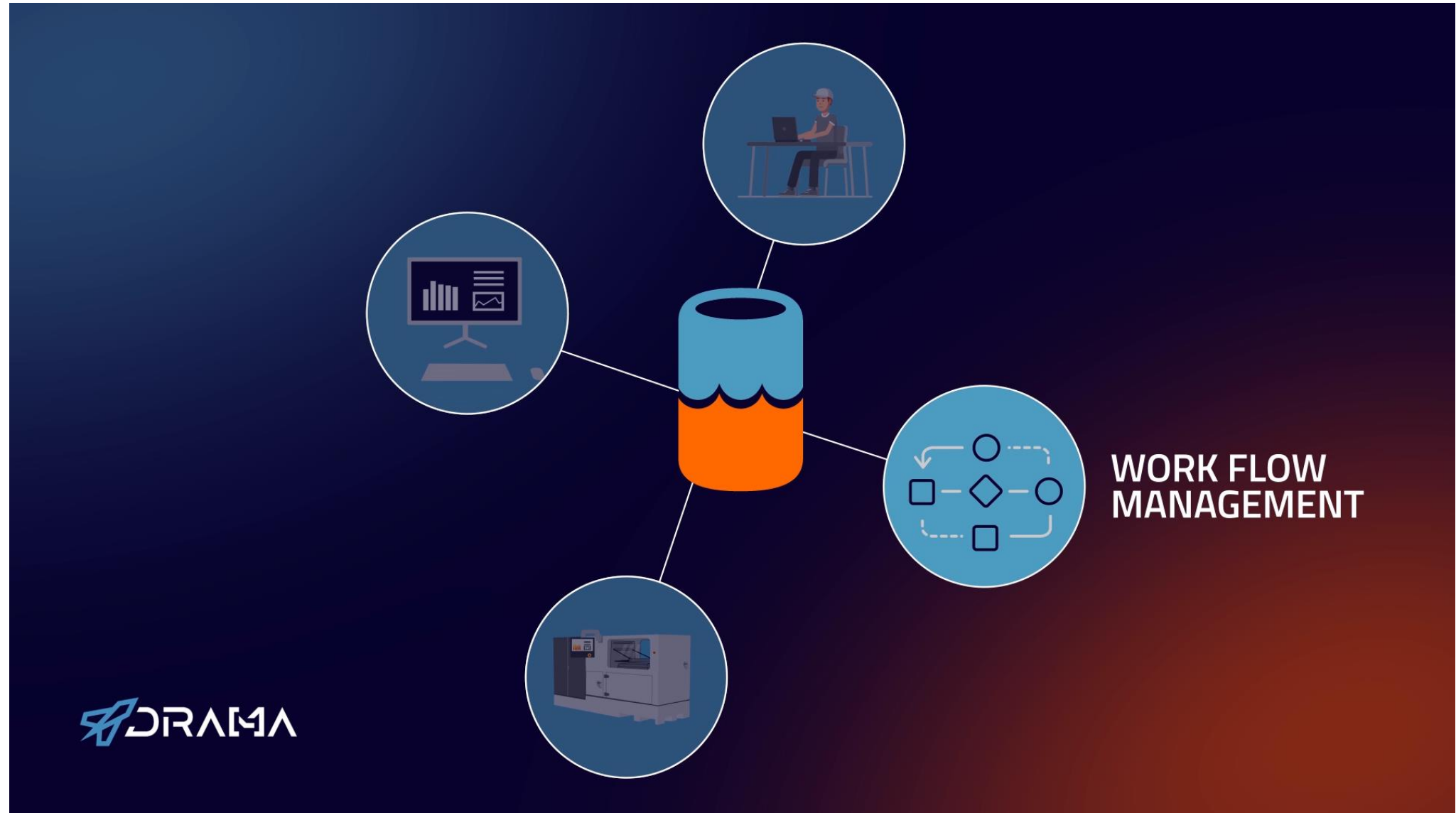


Extracts from ITP manufacturability assessment (Renishaw)



Design for X-ray Inspection (MTC)

# HOW DO I MANAGE MY DATA?



## **Through the DRAMA project the National Centre Additive Manufacturing will:**

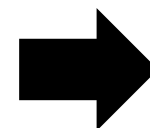
- Provide 20 companies with advice to support their adoption of additive
- Run 10 development projects across Renishaw and National Centre Additive Manufacturing
- Upskill around 40 people from 30 companies
- Provided a facility, training, support packages and online resources to help companies advance in AM.



# UK AEROSPACE TECHNOLOGY INSTITUTE

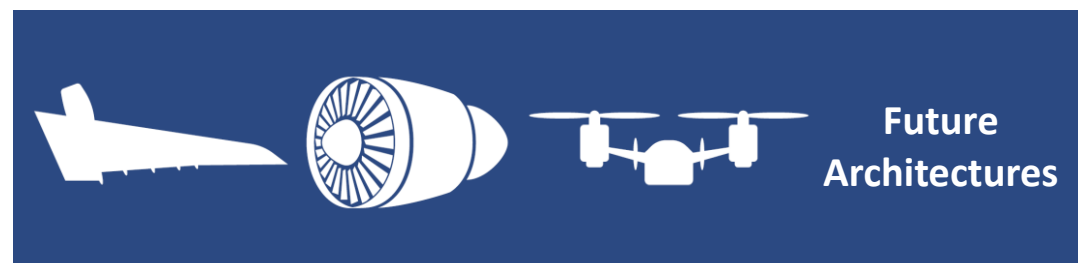
**NATIONAL  
CENTRE  
ADDITIVE  
MANUFACTURING**

## 2018 sector consultation



# UK AEROSPACE TECHNOLOGY INSTITUTE

ATI identified these opportunities for additive in aerospace



# UPCOMING EVENTS



<https://www.eventbrite.co.uk/e/mastering-am-2020-save-the-date-tickets-74816675691>



<https://www.eventbrite.co.uk/e/made-for-space-save-the-date-tickets-65402670147>

**THE END**